



# Evaluation of GOCI, MODIS, and VIIRS Imagery

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# Evaluation of GOCI, MODIS, and VIIRS Imagery Outline

- Background
- Study Site
- Results
  - Spectra
  - Time Series
  - Image/Data Comparisons
  - Full Image
- Conclusions



# Evaluation of GOCI, MODIS, and VIIRS Imagery Background

- MODIS
  - Processed with MOBY gains
- VIIRS
  - Processed with MOBY (blue-water) gains
- GOCI
  - GOCI data from 4 pm GTM, corresponds to local noon
    - Reduces sun glint and sensor issues
- Aeronet SeaPrism
  - Gageocho Aeronet (SeaPrism #624) was moved to leodo
    - Results in a data gap from May 2012 – December 2013



# Evaluation of GOCI, MODIS, and VIIRS Imagery

## Sources of Variability

| Sensor           | MODIS | VIIRS | GOCI | In Situ |
|------------------|-------|-------|------|---------|
| Center Frequency | 412.5 | 412   | 412  | 411     |
|                  | 443   | 445   | 443  | 442     |
|                  | 488   | 488   | 490  | 490     |
|                  | 551   | 555   | 555  | 551     |
|                  | 667   | 672   | 660  | 668     |



# Evaluation of GOCI, MODIS, and VIIRS Imagery leodo nLw to rrs conversion for JD 335 2013

F sub 0 values  
are not for  
same lambda

nLw values are  
not the same

Differences

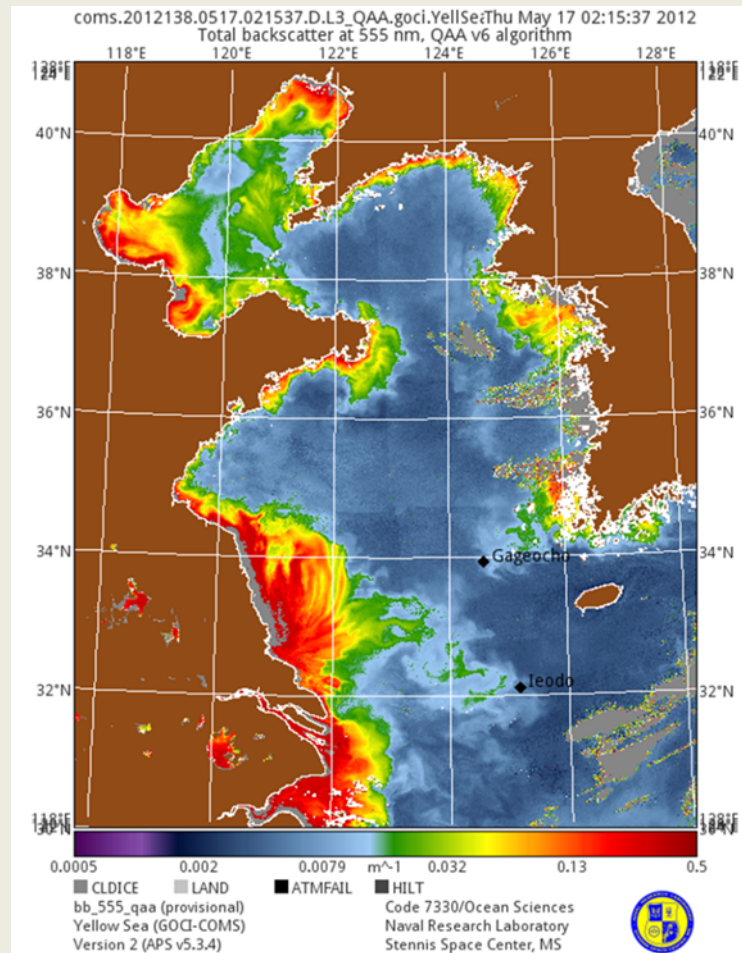
Ratio of  
methods

|                              | nLw(411)   | nLw(442)   | nLw(490)   | nLw(551)   | nLw(668)   |
|------------------------------|------------|------------|------------|------------|------------|
| nLw/Fsub0_eq                 | 0.00966    | 0.01202    | 0.01576    | 0.02097    | 0.007459   |
| nLw/Fsub0_ne                 | 0.00908    | 0.01271    | 0.01654    | 0.02087    | 0.007451   |
|                              |            |            |            |            |            |
| nLw_f/Q/Fsub0_eq             | 0.00851    | 0.01034    | 0.01290    | 0.01658    | 0.006360   |
| nLw_f/Q/Fsub0_ne             | 0.00801    | 0.01093    | 0.01354    | 0.01650    | 0.006353   |
|                              |            |            |            |            |            |
| eq-ne                        | 0.00057    | -0.00069   | -0.00078   | 9.8259E-05 | 8.0951E-06 |
| nLw/Fsub0 -<br>nLw_f/Q/Fsub0 | 0.00051    | -0.00059   | -0.00063   | 7.7676E-05 | 6.9022E-06 |
|                              |            |            |            |            |            |
| eq/ne                        | 1.06355662 | 0.94560905 | 0.95279461 | 1.00470619 | 1.00108642 |
| nLw/Fsub0 /<br>nLw_f/Q/Fsub0 | 1.06355662 | 0.94560905 | 0.95279461 | 1.00470619 | 1.00108642 |



# Evaluation of GOCI, MODIS, and VIIRS Imagery

## Study site - Total Backscatter at 555 nm image



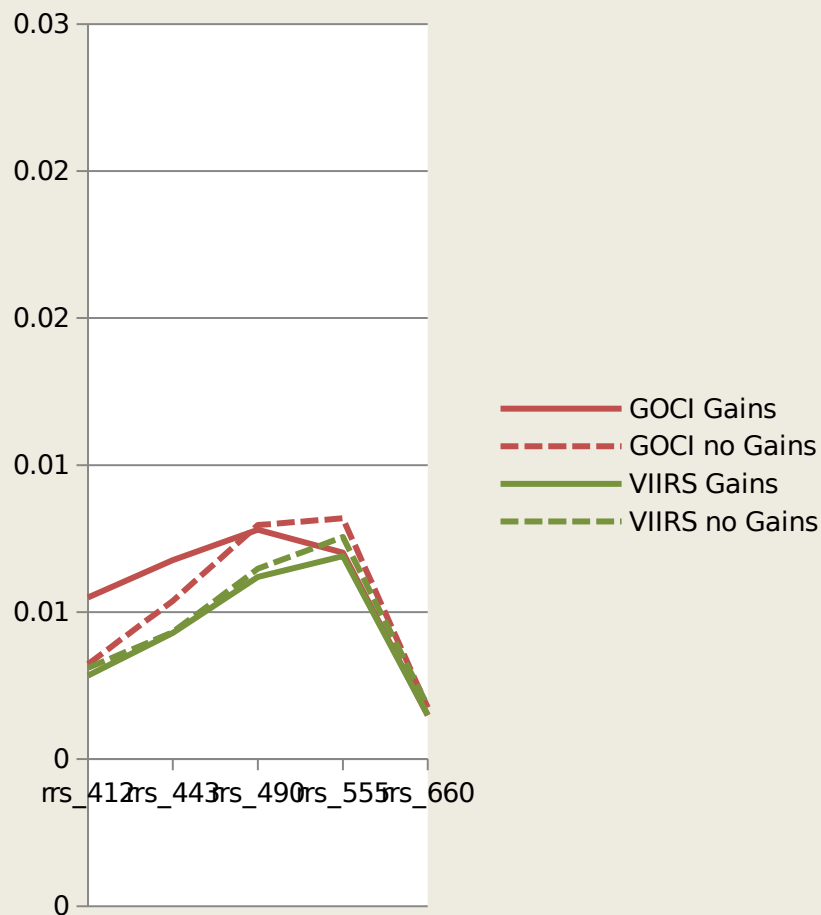
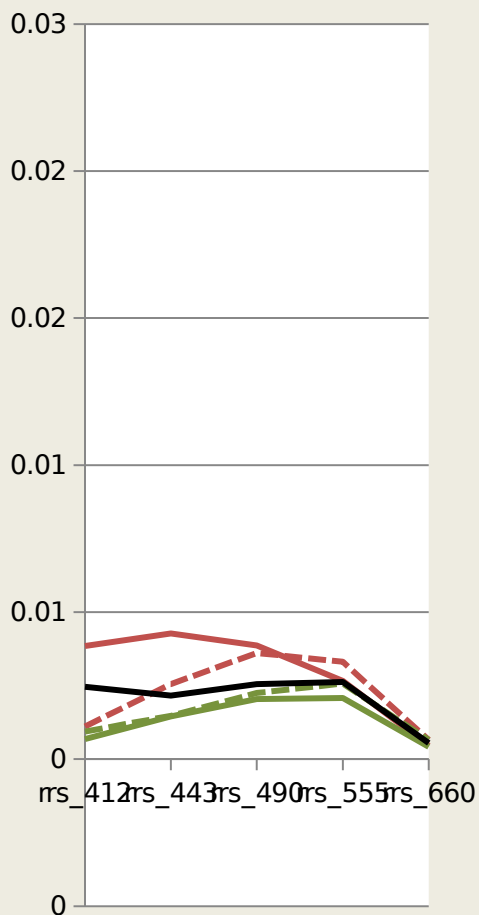


# Evaluation of GOCI, MODIS, and VIIRS Imagery Data Availability

| JD Year     | In situ      | MODIS        | VIIRS | GOCI | Analyzed | Presented |
|-------------|--------------|--------------|-------|------|----------|-----------|
| 085<br>2012 | Gageoc<br>ho | Yes          | No    | Yes  | No       |           |
| 108<br>2012 | Gageoc<br>ho | PRODFAI<br>L | Yes   | Yes  | Yes      |           |
| 117<br>2012 | Gageoc<br>ho | PRODFAI<br>L | Yes   | Yes  | Yes      |           |
| 118<br>2012 | Gageoc<br>ho | Yes          | Yes   | Yes  | Yes      | Yes       |
| 124<br>2012 | Gageoc<br>ho | PRODFAI<br>L | Yes   | Yes  | Yes      |           |
| 138<br>2012 | Gageoc<br>ho | PRODFAI<br>L | Yes   | Yes  | Yes      |           |
| 277<br>2013 | No           | Yes          | Yes   | Yes  | Yes      | Yes       |
| 304<br>2013 | No           | Invalid      | No    | Yes  | No       |           |

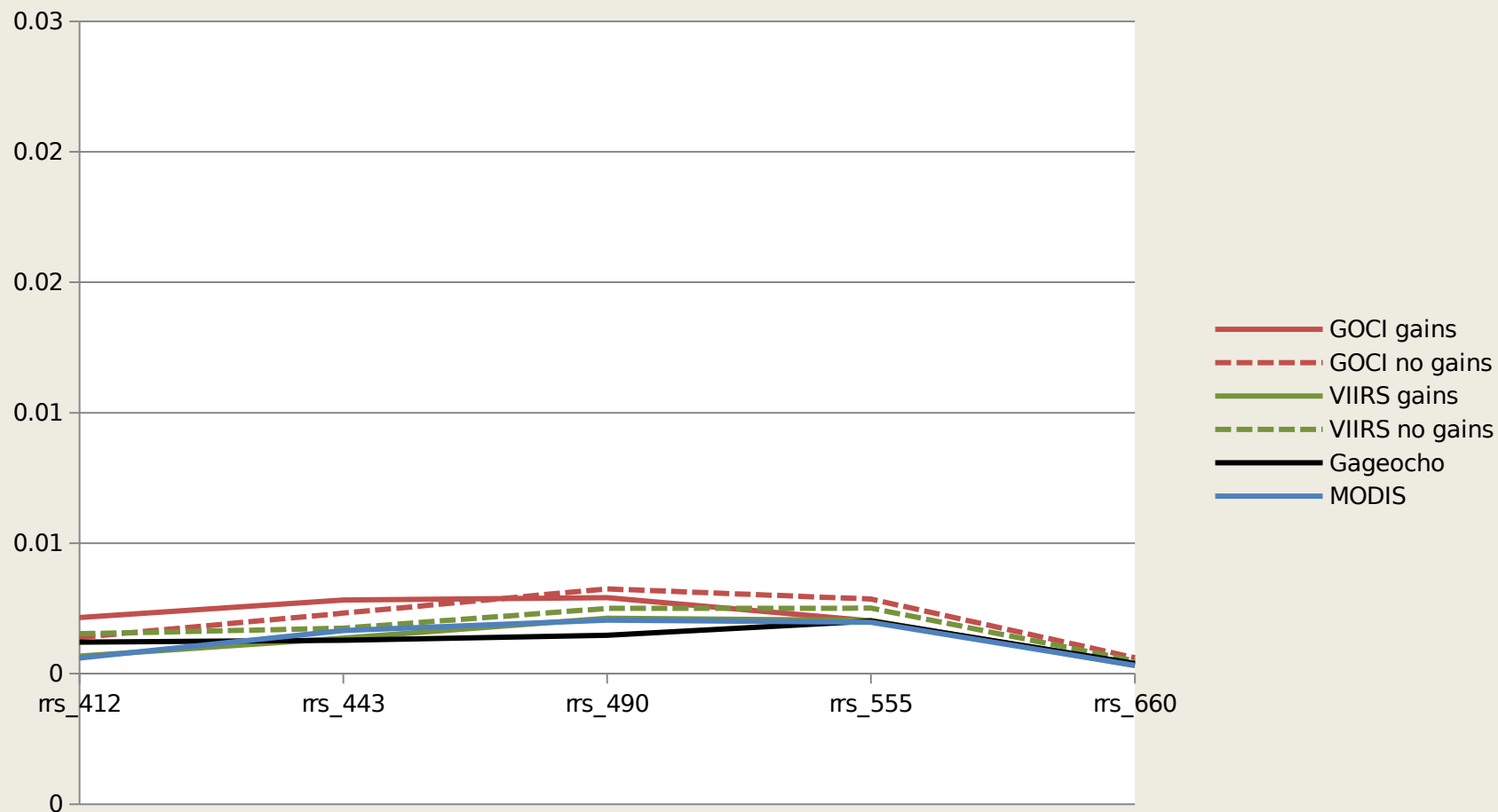


# Evaluation of GOCI, MODIS, and VIIRS Imagery JD 117 2012 Spectra



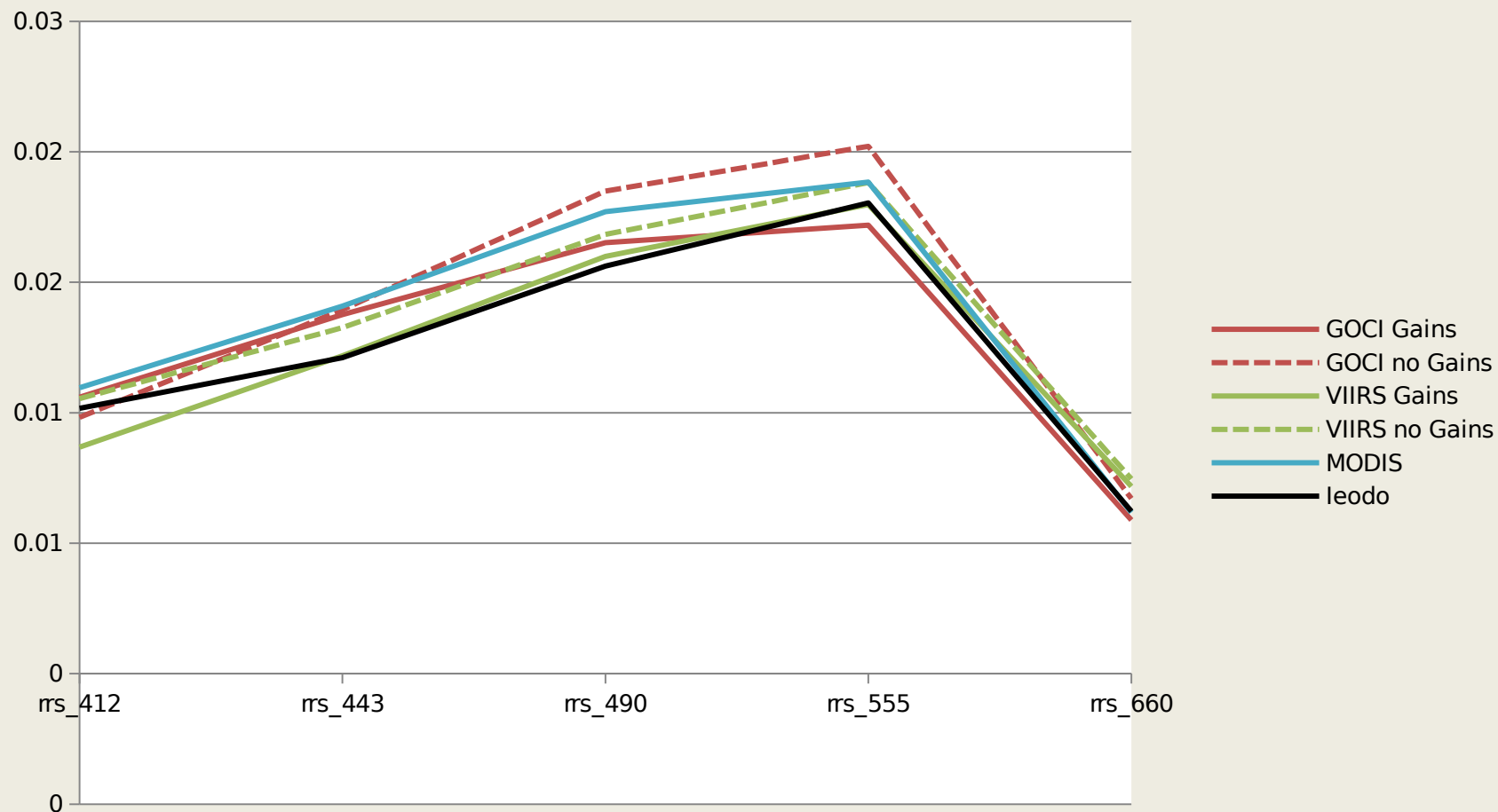


# Evaluation of GOCI, MODIS, and VIIRS Imagery JD 118 2012 Spectra - Gageocho Site





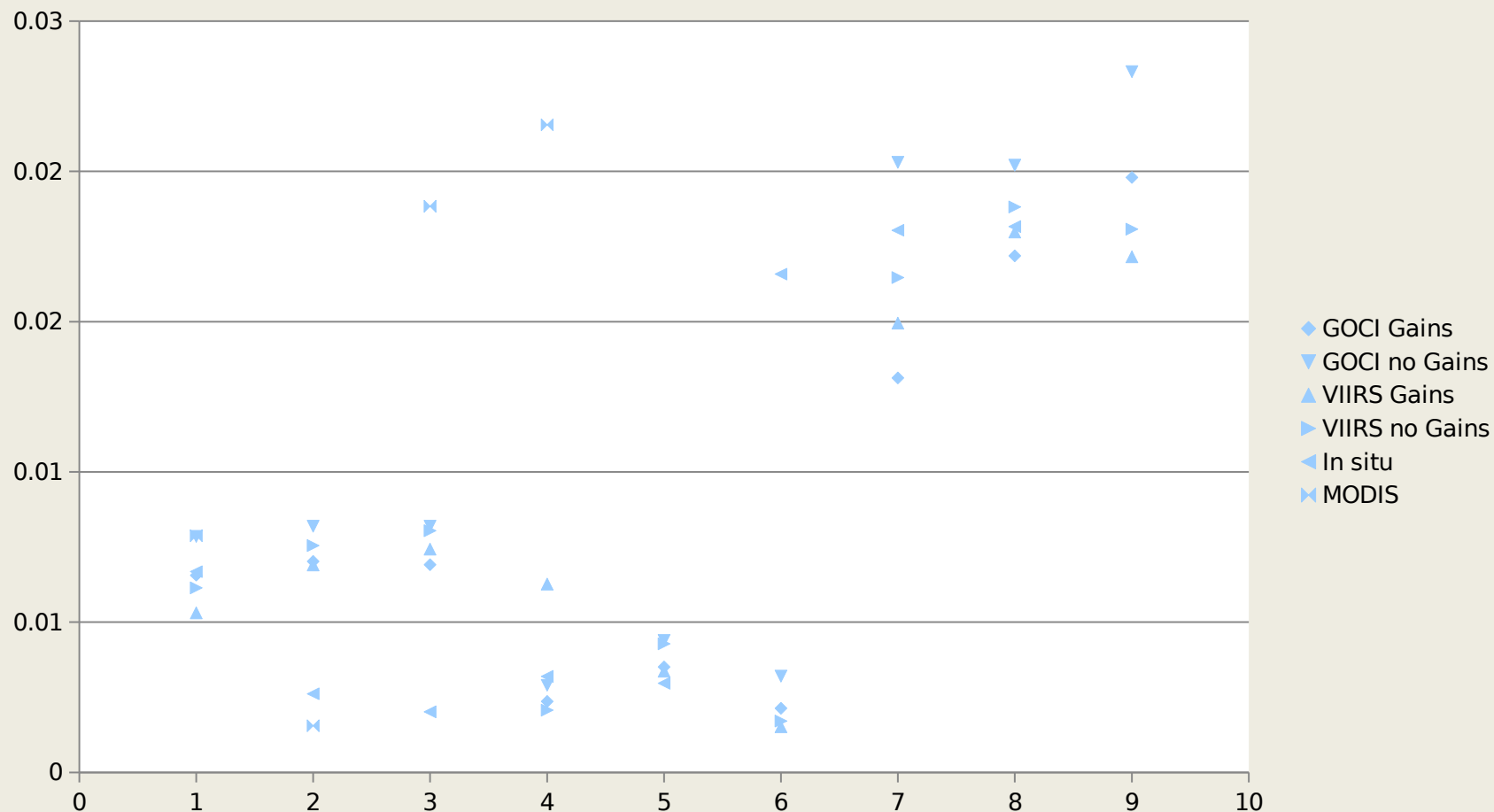
# Evaluation of GOCI, MODIS, and VIIRS Imagery JD 341 2013 spectra - Iedeo Site





# Evaluation of GOCI, MODIS, and VIIRS Imagery

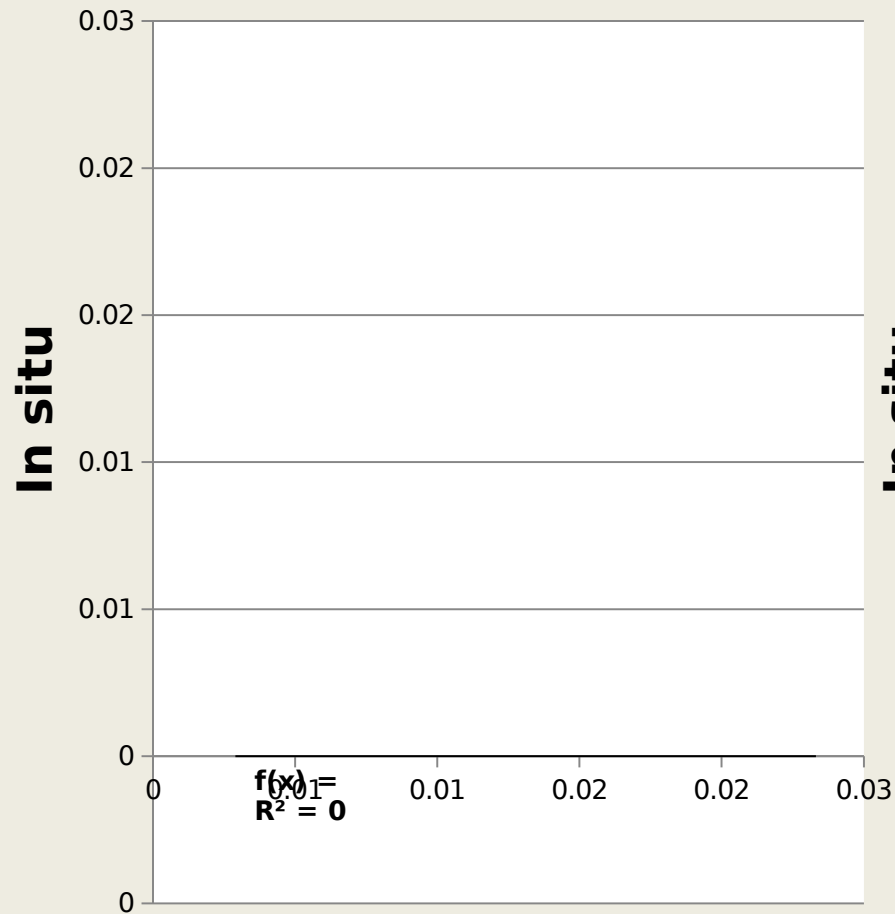
## All sensors time series - rrs 550



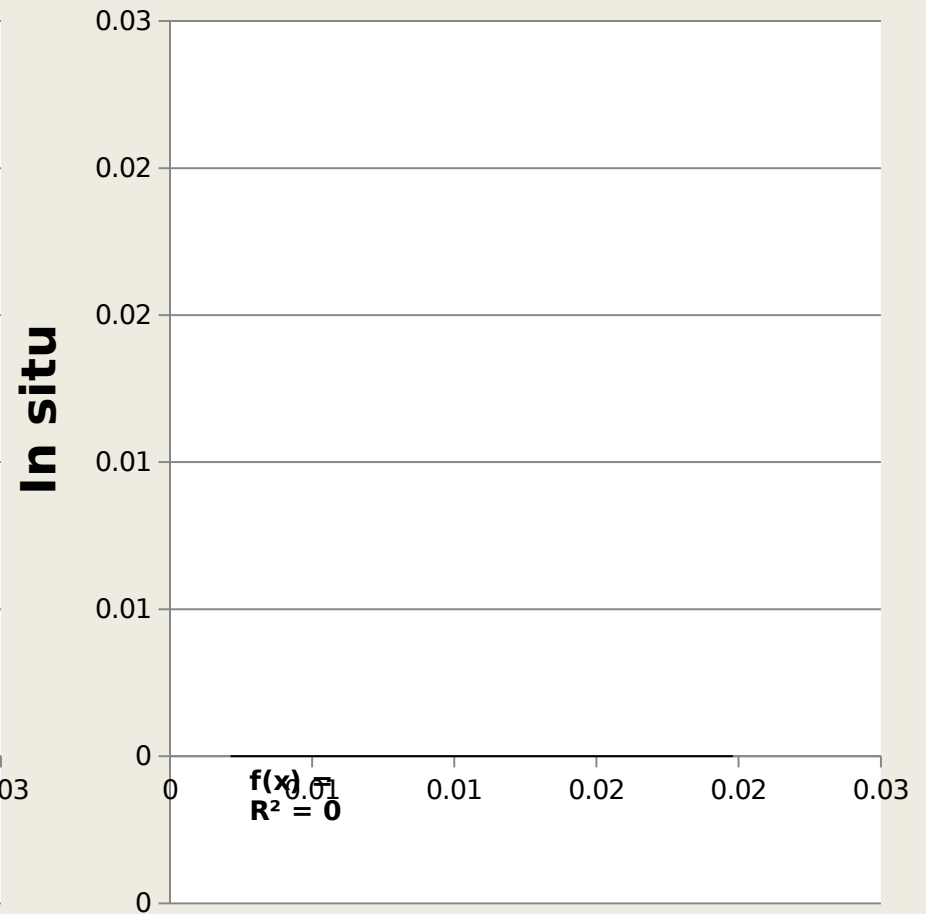


# Evaluation of GOCI, MODIS, and VIIRS Imagery

## rrs 555 GOCI - in situ



**GOCI no Gains**

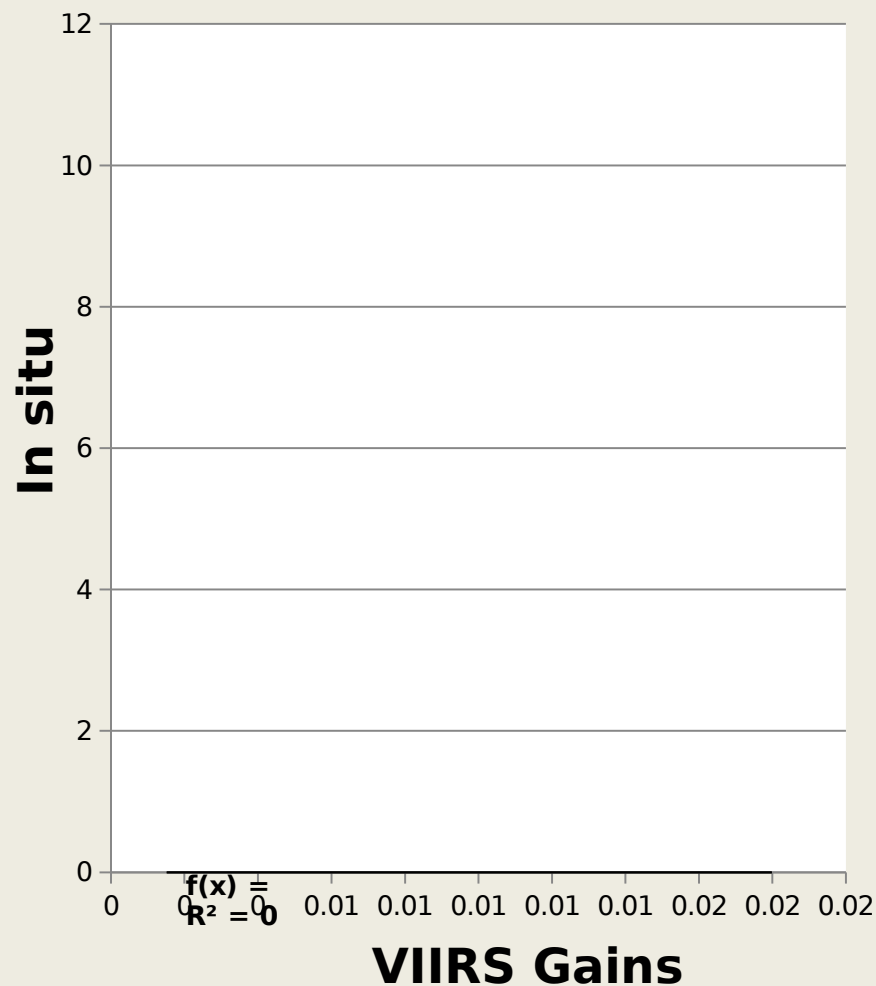
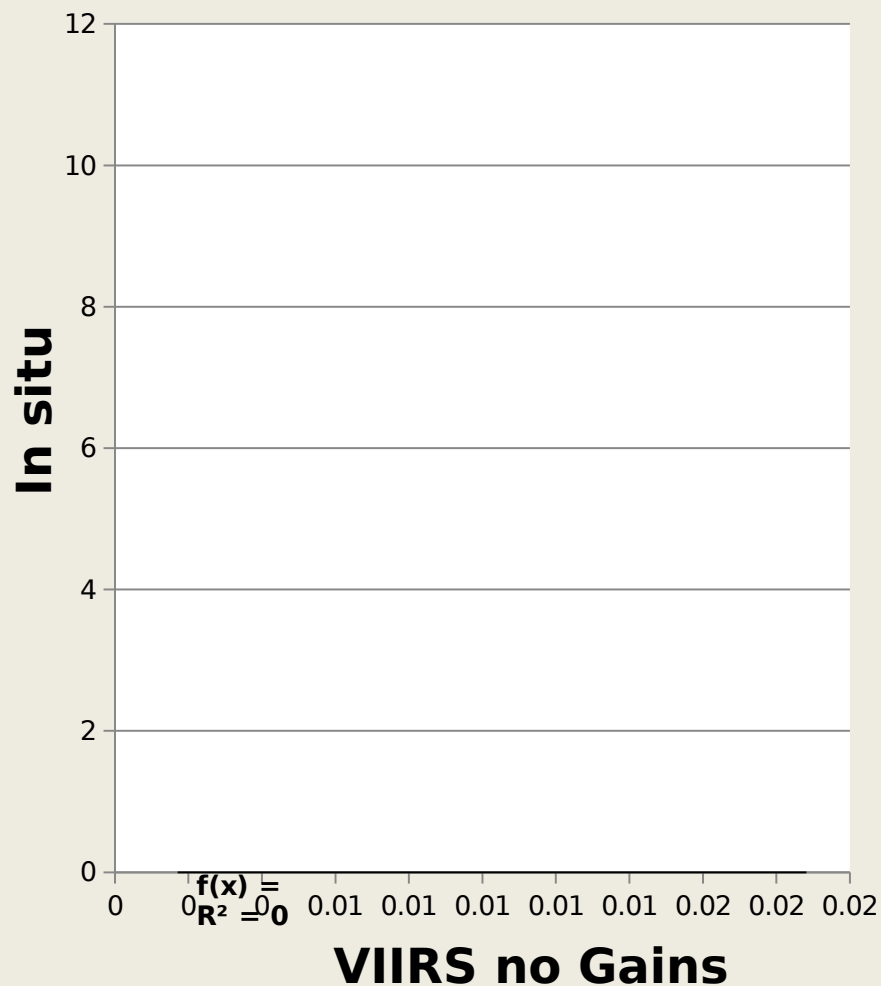


**GOCI Gains**



# Evaluation of GOCI, MODIS, and VIIRS Imagery

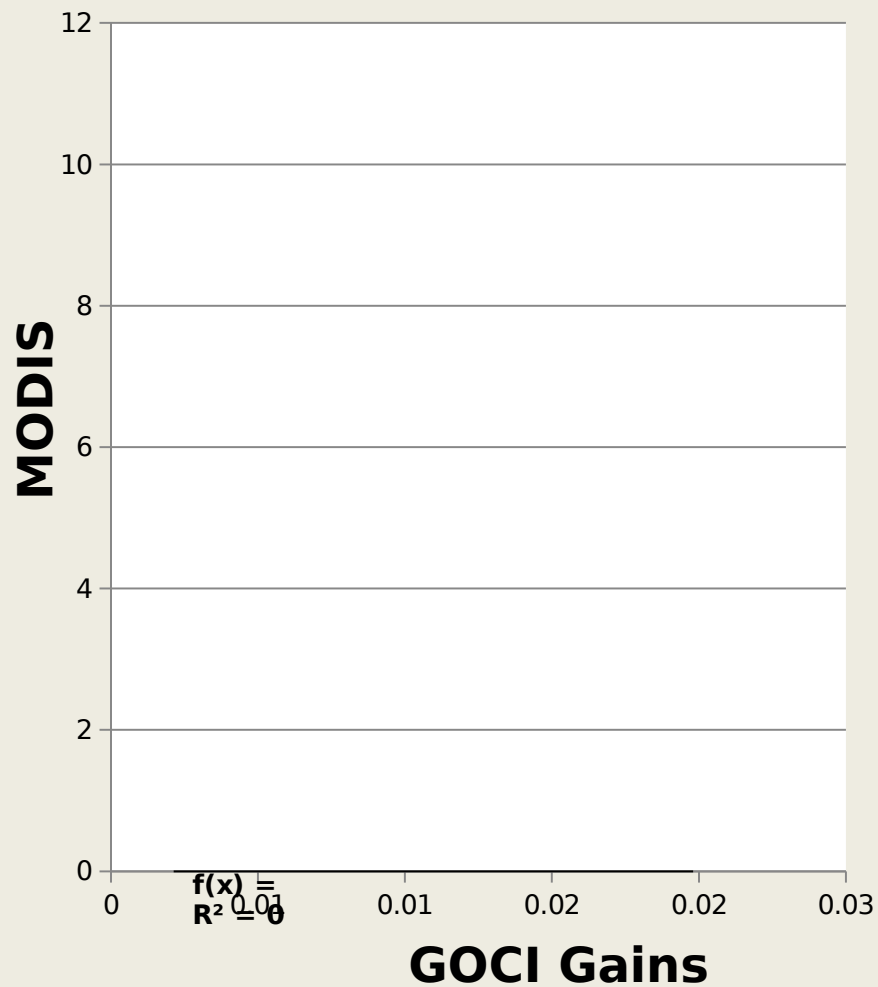
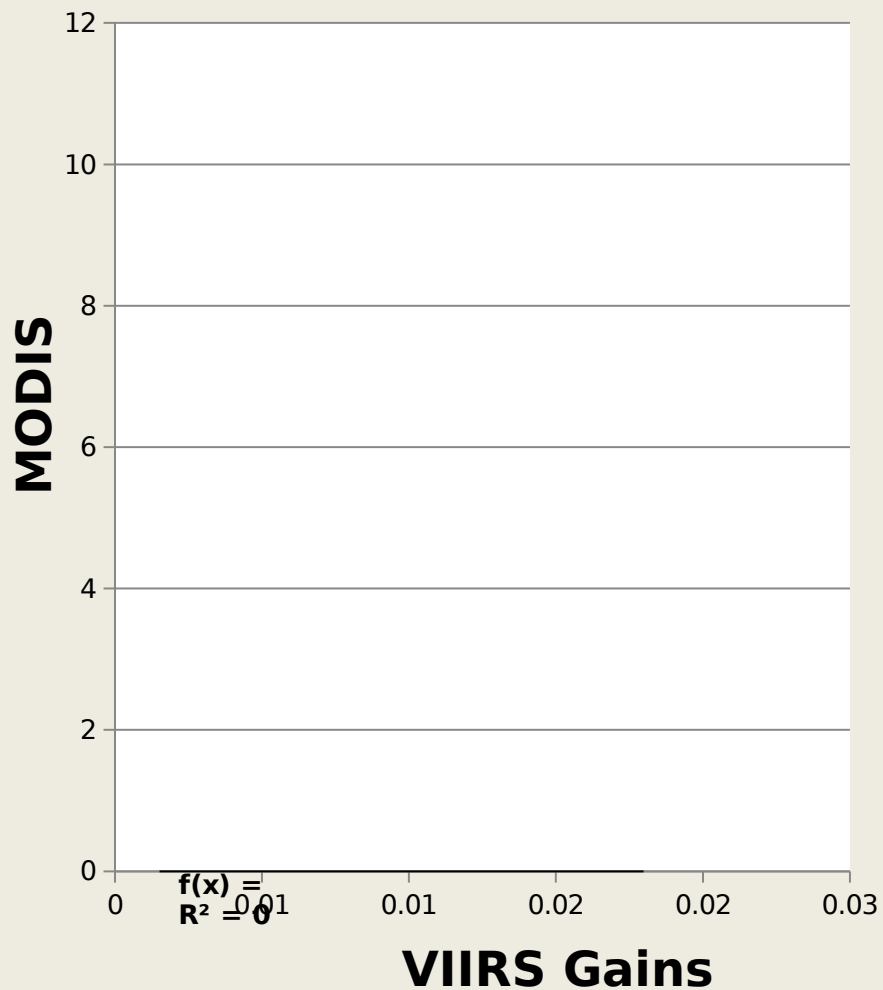
## rrs 555 VIIRS - in situ





# Evaluation of GOCI, MODIS, and VIIRS Imagery

## rrs 555 GOCI/VIIRS - MODIS





# Evaluation of GOCI, MODIS, and VIIRS Imagery

## Sensor Comparisons

| rrs<br>412                                | Slope  | Interce<br>pt | R <sup>2</sup> | rrs<br>443                                | Slope  | Interce<br>pt | R <sup>2</sup> |
|---|--------|---------------|----------------|---|--------|---------------|----------------|
| <b>GOCI<br/>no<br/>Gains<br/>In situ</b>  | 0.9089 | +0.000<br>2   | 0.9056         | <b>GOCI<br/>no<br/>Gains<br/>In situ</b>  | 0.8499 | -<br>0.0012   | 0.8891         |
| <b>GOCI<br/>Gains<br/>In situ</b>         | 0.9061 | -<br>0.0014   | 0.8811         | <b>GOCI<br/>Gains<br/>In situ</b>         | 0.9392 | -<br>0.0028   | 0.8928         |
| <b>GOCI<br/>Gains<br/>MODIS</b>           | 0.8824 | -<br>0.0006   | 0.9407         | <b>GOCI<br/>Gains<br/>MODIS</b>           | 0.9795 | -<br>0.0010   | 0.9930         |
| <b>VIIRS<br/>no<br/>Gains<br/>In situ</b> | 0.8486 | +0.000<br>5   | 0.9060         | <b>VIIRS<br/>no<br/>Gains<br/>In situ</b> | 0.9226 | -<br>0.0006   | 0.8958         |
| <b>VIIRS<br/>Gains<br/>In situ</b>        | 0.9350 | +0.000<br>7   | 0.6379         | <b>VIIRS<br/>Gains<br/>In situ</b>        | 1.0460 | -<br>0.0014   | 0.7464         |
| <b>VIIRS<br/>Gains</b>                    | 1.2074 | -             | 0.0070         | <b>VIIRS<br/>Gains</b>                    | 1.1413 | +0.000        | 0.0860         |



# Evaluation of GOCI, MODIS, and VIIRS Imagery

## Sensor Comparisons

| rrs 490                       | Slope  | Interce pt | R <sup>2</sup> | rrs 660                       | Slope  | Interce pt | R <sup>2</sup> |
|-------------------------------|--------|------------|----------------|-------------------------------|--------|------------|----------------|
| <b>GOCI no Gains In situ</b>  | 0.9362 | - 0.0023   | 0.8411         | <b>GOCI no Gains In situ</b>  | 0.8458 | - 0.0004   | 0.9718         |
| <b>GOCI Gains In situ</b>     | 0.9362 | - 0.0011   | 0.6347         | <b>GOCI Gains In situ</b>     | 1.0452 | - 0.0004   | 0.9542         |
| <b>GOCI Gains MODIS</b>       | 1.1021 | - 0.0011   | 0.9966         | <b>GOCI Gains MODIS</b>       | 1.0653 | - 0.0002   | 0.9984         |
| <b>VIIRS no Gains In situ</b> | 1.0249 | - 0.0020   | 0.8653         | <b>VIIRS no Gains In situ</b> | 1.0248 | - 0.0005   | 0.9562         |
| <b>VIIRS Gains In situ</b>    | 1.1840 | - 0.0034   | 0.8163         | <b>VIIRS Gains In situ</b>    | 1.0489 | - 0.0007   | 0.8498         |
| <b>VIIRS Gains MODIS</b>      | 1.1783 | - 0.0004   | 0.9999         | <b>VIIRS Gains MODIS</b>      | 1.0564 | - 0.0002   | 0.9973         |



# Evaluation of GOCI, MODIS, and VIIRS Imagery Statistics for Sensor Comparisons

| <b>rrs 555</b>                        | <b>Slope</b>  | <b>Intercept</b> | <b>R<sup>2</sup></b> |
|---------------------------------------|---------------|------------------|----------------------|
| <b>GOCI no Gains<br/>In situ</b>      | <b>0.8865</b> | <b>-0.0018</b>   | <b>0.9143</b>        |
| <b>GOCI Gains<br/>In situ</b>         | <b>1.0809</b> | <b>-0.0016</b>   | <b>0.8635</b>        |
| <b>GOCI Gains<br/>MODIS</b>           | <b>1.1183</b> | <b>-0.0004</b>   | <b>0.9980</b>        |
| <b>VIIRS no<br/>Gains<br/>In situ</b> | <b>1.0558</b> | <b>-0.0020</b>   | <b>0.8764</b>        |
| <b>VIIRS Gains<br/>In situ</b>        | <b>1.2124</b> | <b>-0.0032</b>   | <b>0.8921</b>        |
| <b>VIIRS Gains<br/>MODIS</b>          | <b>1.1639</b> | <b>-0.0004</b>   | <b>0.9737</b>        |



# Evaluation of GOCI, MODIS, and VIIRS Imagery

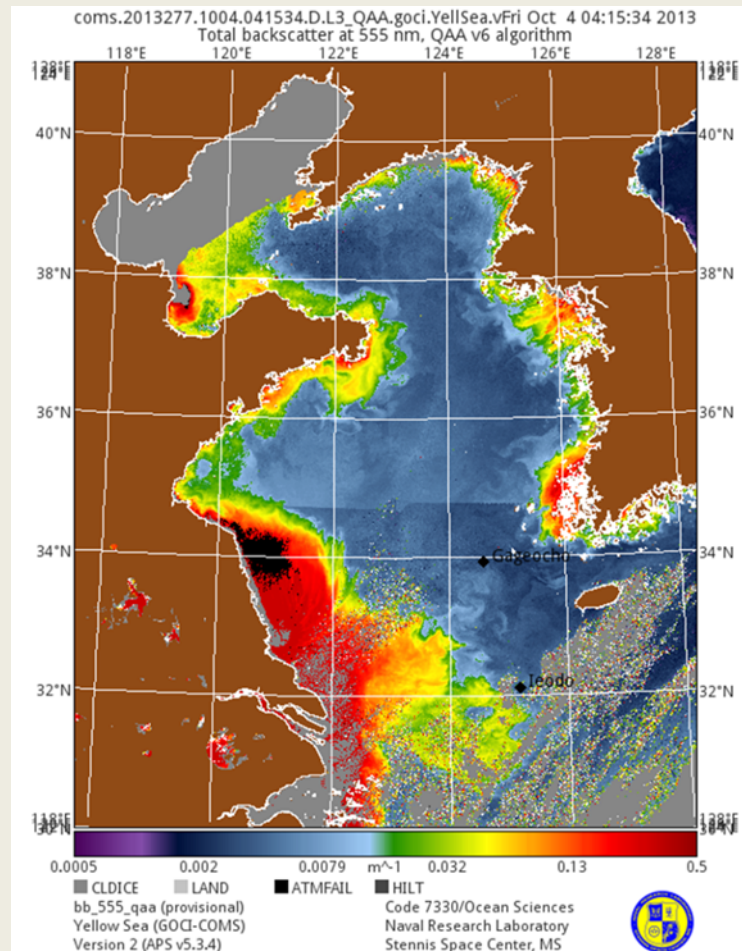
## Single Point to Full Image comparison

| <b>R<sup>2</sup> Values</b> | <b>Single Sample, Multiple Images</b> |                    | <b>Single Image, all samples</b> |                    |
|-----------------------------|---------------------------------------|--------------------|----------------------------------|--------------------|
| <b>Channel</b>              | <b>GOCI-MODIS</b>                     | <b>VIIRS-MODIS</b> | <b>GOCI-MODIS</b>                | <b>VIIRS-MODIS</b> |
| <b>412</b>                  | <b>0.941</b>                          | <b>0.998</b>       | <b>0.834</b>                     | <b>0.942</b>       |
| <b>443</b>                  | <b>0.993</b>                          | <b>0.987</b>       | <b>0.923</b>                     | <b>0.971</b>       |
| <b>490</b>                  | <b>0.997</b>                          | <b>0.990</b>       | <b>0.976</b>                     | <b>0.985</b>       |
| <b>555</b>                  | <b>0.998</b>                          | <b>0.974</b>       | <b>0.984</b>                     | <b>0.990</b>       |
| <b>690</b>                  | <b>0.998</b>                          | <b>0.897</b>       | <b>0.975</b>                     | <b>0.983</b>       |



# Evaluation of GOCI, MODIS, and VIIRS Imagery

## JD 277 GOCI Total Backscatter at 555 nm Image

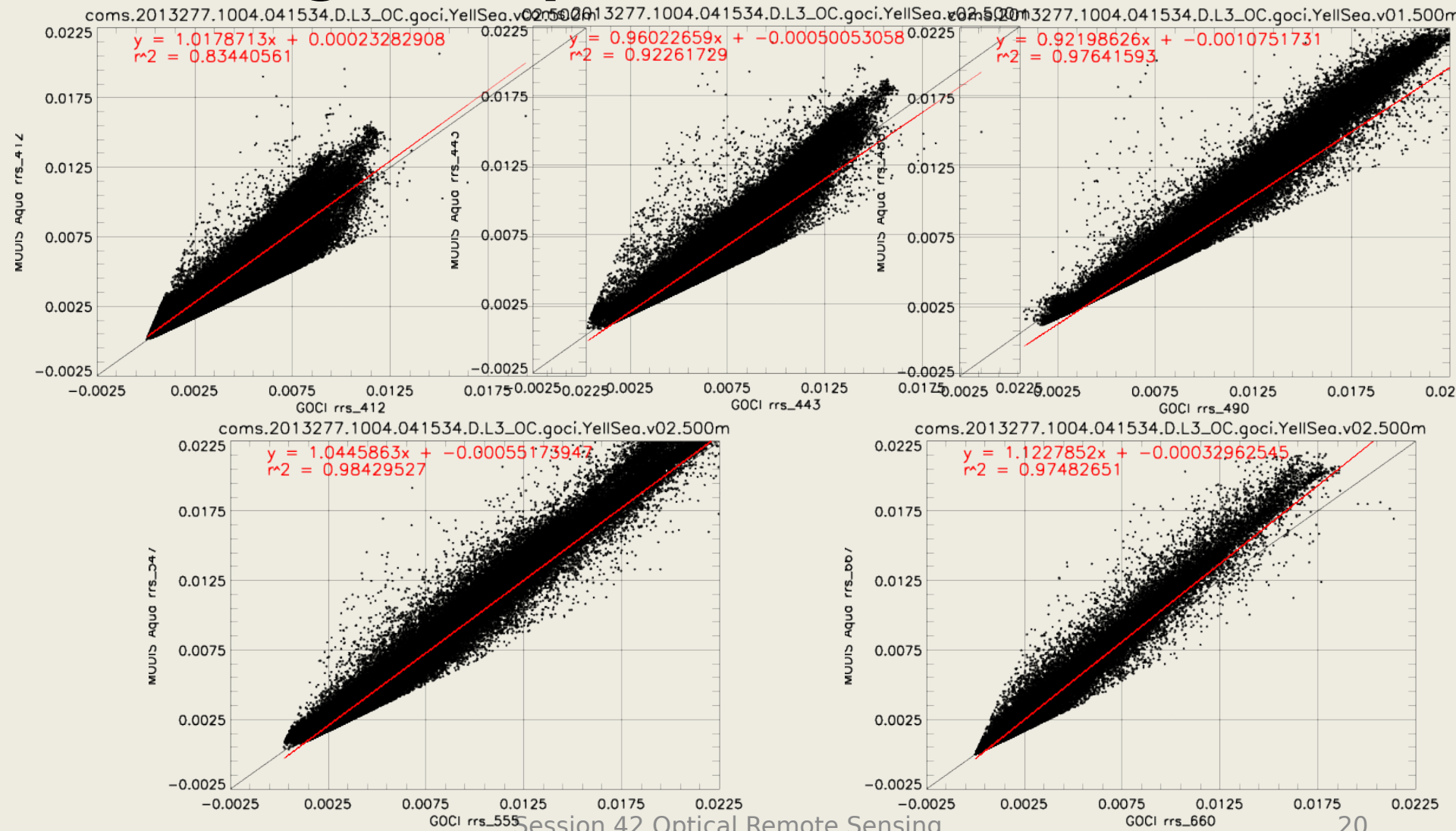




# Evaluation of GOCI, MODIS, and VIIRS Imagery

## JD 277 MODIS - GOCI

### Image Comparison

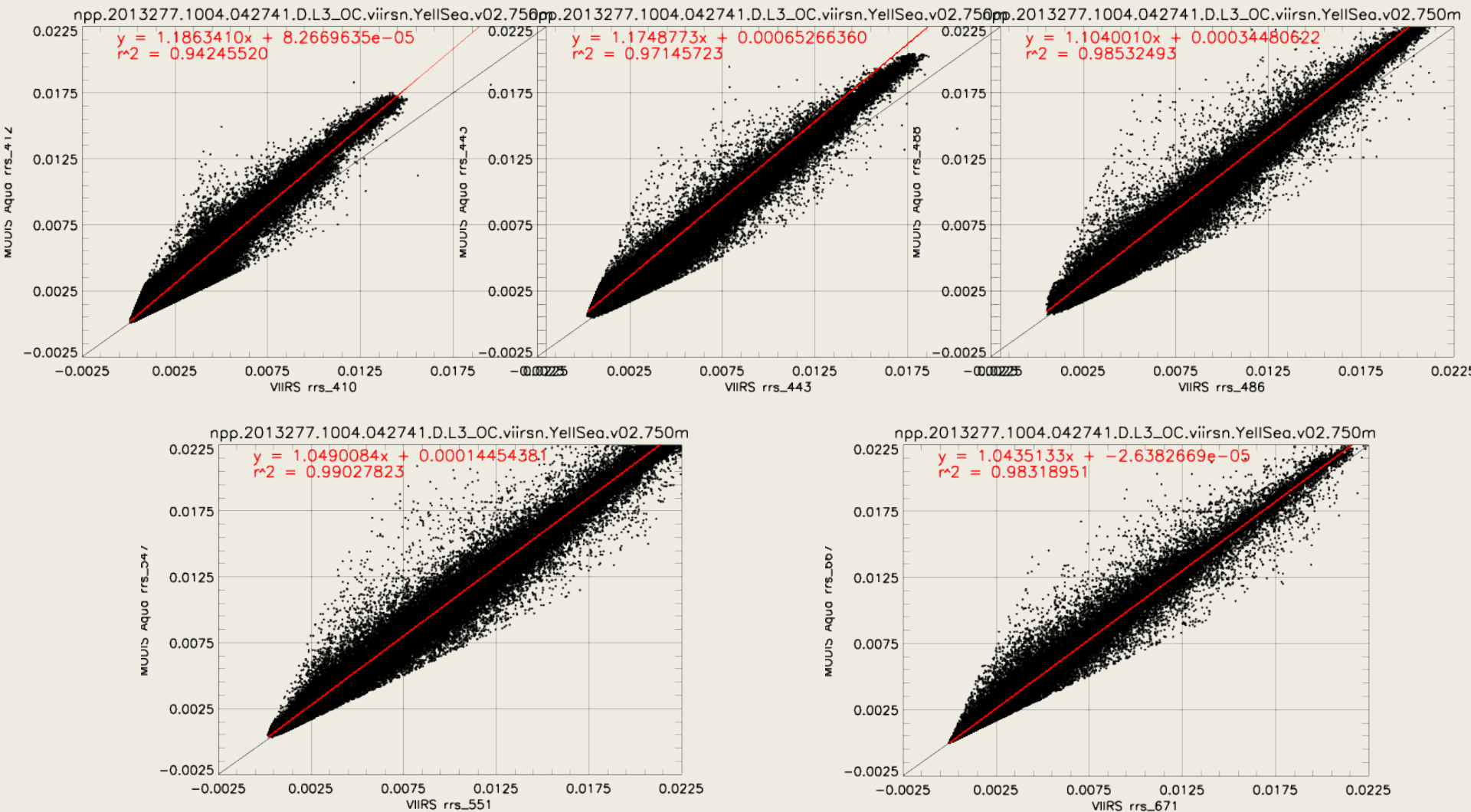




# Evaluation of GOCI, MODIS, and VIIRS Imagery

## JD 277 MODIS - VIIRS

### Image Comparison





# Evaluation of GOCI, MODIS, and VIIRS Imagery

## Conclusions

- VIIRS and GOCI compare favorably to MODIS in the Yellow Sea
- R2 values impacted by the green water sites at leodo
  - Optical properties at two sites are different, Gageocho more representative of blue water and leodo more representative of mixed water
  - MOBY (blue water) gains applied to VIIRS do not work as well in green water
- Data from single points and imagery show similar statistics
- Application of gains lowers rrs in most cases



# Evaluation of GOCI, MODIS, and VIIRS Imagery Future Efforts

- Develop green-water gains for VIIRS and MODIS